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A complete coal mine survey

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Department:

A COMPLETE COAL MINE SURVEY.

THESIS

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ILLUSTRATIONS

INTRODUCTION.

As an introduction to this thesis, it would probably be well to give the laws of the State of Illinois relative to mine maps. These laws come under "An Act to revise the laws in relation to the coal mines and subjects relating thereto, and providing for the health and safety of persons employed therein. Approved June 6, 1911, inforce July 1, 1911. L. 1911, p. 388."

Section 7 reads as follows:

(a) The operator of every coal mine in the State shall make, or cause to be made, an accurate map or plan of such mine, drawn to a scale not smaller than 200 feet to the inch. All measurements shall be in feet and decimals of a foot. On such maps shall appear the name of the State, country and township in which the mine is located, the designation of themine, the name of the company or owner, the certificate of the mining engineer or surveyor as to the accuracy and date of the survey, thenorth point and the scale to which the drawing is made.

Surface Survey. (b) Such map or plan shall accurately show the surface boundary lines of the coal rights pertaining to each mine, and all sections or quarter-section lines or corners within the same; the lines of town lots and streets; the tracks and side-tracks of

all railroads, and the location of all wagon roads, rivers, streams, ponds, location and depth of holes drilled for oil, gas or water that penetrate a workable coal seam, and the elevation above the coal seam of any stream or body of water that might endanger the mine.

Underground Survey. (c) For the underground workings, said maps shall show all shafts, slopes, tunnels or other openings to the surface or to the workings of a contiguous mine; all excavations, entries, rooms and cross-cuts; the location of the fan or furnace and the direction of the air currents; the location of pumps, hauling engines, engine planes, abandoned works, fire walls and standing water; and the outcrop line of the seam, if any, on the property.

The general outline of all areas in which pillars have been drawn shall be indicated on themap.

Each underground map also shall show, in feet and decimals thereof, the elevation of the floor of the coal at reasonable intervals on the main entries and cross entries from the bottom of the shaft to the face of the workings; such elevations shall be referred to the floor of the coal at the bottom of the hoisting shaft.

Map For Every Seam. (d) A separate and similar map, drawn to the same scale, shall be made of each and

every seam, which, after the passage of this Act, shall be worked in any mine, and the maps of all such seams shall show all shafts, inclined planes or other passage-ways connecting the same.

Separate Maps For The Surface. (e) A separate map also shall be made of the surface whenever the surface buildings, lines or objects are so numerous as to obscure the details fo the mine workings if drawn upon the same sheet with them, and in such case the surface map shall be drawn on transparent cloth or paper, so that it can be laid upon the map of the underground workings, and thus indicate the relation of lines and objections on the surface to the excavations of the mine.

The Dip. (f) Each map shall also show by profile drawing and measurements, in feet and decimals thereof, the rise and dip of the seam from the bottom of the shaft in either direction to the face of the workings.

Copies For Inspectors and Recorders. (g) The original or true copies of all such maps shall be kept in the office at the mine, and one true copy thereof shall be furnished to the State inspector of mines for the district in which said mine is located, and one shall be filed in the office of the recorder of the county in which the mine is located, within thirty days after the

completion of the same. The maps so delivered to the inspector and to the recorder shall remain in the custody of said inspector and recorder during their respective terms of office, and be delivered by them to their successors in office. They shall be kept at the office of the inspector and of the recorder, and be open to the examination of all persons interested in the same, but such examination shall be made only in the presence of the inspector or the recorder. Neither the inspector nor the county recorder shall permit any copies of the same to be made without the written consent of the operator or the owner of the property.

The county recorder shall properly index such map as part of the title record of the property affected.

A copy of each map and extensions to the same shall be furnished the mine rescue station commission for use in connection with rescue work only.

Annual Surveys. (h) An extension of the last preceding survey of every mine in active operation shall be made once in every twelve months prior to July 1, of every year, and the results of said survey, with the date thereof shall be promptly and accurately entered upon the original maps and all copies of the same, so as to show all changes in plan or new work in themine, and all

extensions of the old workings to the most advanced face or boundary of said workings which have been made since the last preceding survey. The State inspector, the county recorder and the rescue station commission shall be furnished with a copy of the said extended map or of the extensions to said map.

Abandoned Mines. (i) When any coal mine is worked out or is about to be abandoned or indefinitely closed, the operator of the same shall make, or cause to be made, a final survey of such mine; to show the entire worked out area when the mine was closed, and the results of the same shall be duly extended on all maps of the mines and copies thereof herein required to be filed. The shaft, slope or drift opening into any such abandoned mine shall be kept securely enclosed.

Special Survey. (j) The State inspector of mines, or theState Mining Board, may order a survey to be made of the workings of any mine in addition to the regular annual survey, the results to be extended on the maps of the same and the copies thereof, whenever the safety of the workmen, unlawful injury to the surface, unlawful encroachment upon adjoining property, or the safety of an adjoining mine requires it.

If the State inspector of mines of the State Mining Board shall believe any map required by this Act is ma-

terially inaccurate or imperfect, theState inspector or State Mining Board is authorized to make, or cause to be made, a correct survey and map at the expense of the operator, the cost recoverable as for debt, provided if such test surveys shows the operator's map to be orrect, the State shall be liable for the expense incurred, payable in such manner as other State accounts incurred by the State Mining Board.

Penalties For Failure. (k) If an operator of any mine refuses or wilfully neglects, for a period of three months, to furnish the said State inspector, the county recorder and the manager of the rescue stations the map or plan of such mine, or a copy thereof, or of the extensions thereto, as provided for in this Act, such operator shall be deemed guilty of a misdemeanor, and on conviction thereof shall be fined not less than ten dollars nor more than one hundred dollars, in the discretion of the court, and shall stand committed to the county jail until such fine is paid, and, in addition thereto, the State inspector or State Mining Board is hereby authorized to make, or cause to be made, an accurate map or plan of such mine at the expense of the operator thereof; and the cost of the same may be recovered by law from the operator in the same manner as other debts by suit, in the name of theState inspector or the State Mining Board,

and for his use, and copies of the same shall be filed by him or the board, one each with said recorder and Mine Rescue Commission. (Amended by Act, approved June 28, 1915; in force July 1, 1915; L. 1915, p. 505.

These laws are but in very few cases strictly adhered to in making the maps. For instance very few maps, if any, show the elevation of the seam at reasonable intervals, and are accompanied by a profile, as referred to under (c) and (f).

PART I

FIELD WORK.

The Top Survey.

Very little explanation will be necessary in regards to the top work, as the field notes themselves are self-explanatory. The survey of the boundary was started from the base line at the shaft. (A-B; see notes on shaft plumbing). The azimuth method was used. In cases where no stone could be found at the corners, fence corners were used instead.

The Shaft Plumbing.

The two shaft system was used in carrying the line underground. The fan was stopped, and a wire suspended in the air shaft from a heavy timber thrown across the shaft and spiked down. The same was done at the main shaft, being careful here that the wire did not come in contact with the shaft timbering, and also that it did not interfere with the cage moving up and down. No. 20 gauge copper wire was used with about five feet of fine steel wire at the bottom end. Eight pound sash weights

were used, and these partly submerged in light oil.

The preliminary preparations having been completed, the survey between the wires on top was made. The party then moved to the shaft bottom, and stations 1 and 2 were set in the heavy 12 x 12 timbers with which the bottom is timbered. As soon as the wires stopped swinging the underground traverse between the two wires was run with 1 to 2 assumed as being north.

The traverse sheets give the calculations and explain how the true bearing of 1 to 2 was determined.

The Underground Survey.

The seam of coal at this mine is about five feet in thickenss. The bottom is of clay, and the top of very bad slate which breaks up and crumbles soon after the coal has been mined out from under it, and it becomes exposed to the air. This necessitates a large amount of timbering. Cross bars sup orted by props are set about eighteen inches apart along all entries and down the center line of the rooms. In many cases lagging is placed above the cross bars after a fall has occurred or the top has been brushed to get more height. From five to eight inch timber is used for this work. In all cases where an entry, room, or cross-cut is turned off an entry, a collar bar is set. These are usually of ten or

twelve inch timber except for cross cuts that are not used as a haulage way.

The entries are driven nine feet wide with a thirty foot pillar between. Cross cuts are also driven nine feet wide. The specifications for rooms in machine territory are that they be turned on fifty-three foot centers, with a nine foot neck, and widened to twenty-eight feet. In solid territory they are to be turned on forty eight foot centers, with an eight foot neck, and widened to twenty-eight feet.

The underground survey was started at station 2, using station 1 as a backsight. The azimuth method of traversing was used throughout. Stations were set as far apart as possible along the main entries, the foresight rodman going ahead to the greatest distance at which he could see the light at the instrument, and setting a station at this point. This method was followed until the mouth of the first working stub entry was reached, at which point and at all stub entries after this, a station necessarily had to be set. With the instrument set up at a station at a stub entry, one station was set in the stub entry and the sight taken on it, after the station ahead in the main entry had been set and sighted on. As the measurements between the stations

were taken the plusses of the cross-cuts were noted.

It was necessary to set sights at the face of the 21 and 22 East entries. To do this, Sta. 218 (Fig.1) was set at the cross-over near the face. With the instrument set up at Sta. 218, two spads were lined in

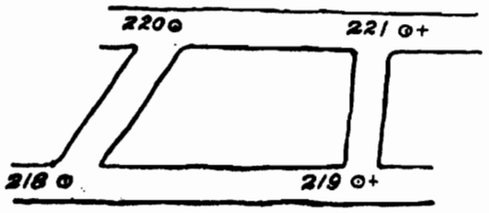


FIG. I.

about three feet apart on an azimuth of 90 degrees. They were set about twenty feet from the face, as were all sights in this survey, except where otherwise noted. The rear one of these two spads was taken as the station and measured to. The notes show this, the station being designated by ⊙ and the sight by + . The condition of the timbers holding the two spads being the same, it was made a general rule to make the rear one the station. This completing the sights for the 21 East, the vernier plate clamp was loosened and the telescope swung around and a sight taken on the approximate position of Sta. 220. The vernier reading gave the azimuth. With this bearing as a basis, and with the aid of a pocket traverse table, (Standard Field Tables, General Land Office) the distance necessary to get a latitude of approximately 39

feet (30 ft. pillar plus 4½ ft. in each entry) was computed. Sta. 220 was then set at this distance from Sta. 218. From Sta. 220, Sta. 221 and the sight were lined in on an azimuth of 90 degrees.

The method of making the survey of the stub entries was practically the same as in the main entry. The line was carried in only one of a pair of entries, the other entry being located by lines through all cross-overs and open cross-cuts. In measuring between stations, the plus distances of the rooms as well as the cross-cuts had to be noted. The 1st and 2nd South and the 3rd and 4th South entries having been stopped it was not necessary to set sights in these. In all the other stub entries sights were set. This was done in the same manner as explained for the 21st and 22nd East atries.

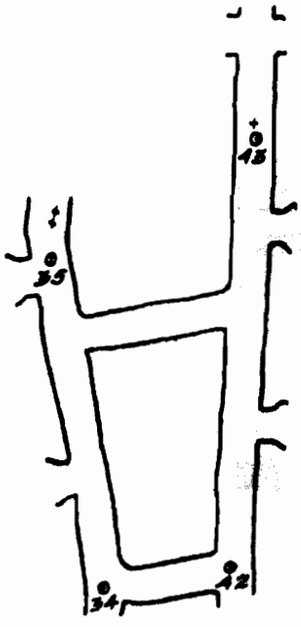


Fig. 2

The 3rd and 4th stubs presented a situation which is not uncommon for one to encounter in making a survey of a mine which has been neglected in regards to sights for sometime. On setting up at Sta. 34 (Fig. 2), and sighting towards the face it was seen that sights could not set on an azimuth of 0 degrees from this station. Sta. 35 was set near the face in the center of the entry, and a sight taken on it and

the distance measured. Sta. 42 was then set in the center of the other entry, and the traverse extended to it. Having set up the instrument at Sta. 42, on sighting towards the face, it was again seen that sights could not be set, so Sta. 43 was set, sighted on, and measured to. With the aid of the traverse table the traverse 35-34-42-43 was figured for departures, and the difference in total departure between Sta. 35 and Sta. 43 found to be 50 ft. This being 11 ft. too much, it was necessary that sights be set which would bring the entries together. From Sta. 43, a sight was lined in on an azimuth of 0 degrees. From Sta. 35, sights were lined in on an azimuth of 5 degrees. For an angle of 5 degrees and a departure of 11 ft. the distance is 127 ft. An order was given the mine manager to stop the 3rd North entry at 130 ft. from Sta. 35 until the sights were changed.

After the traverse work in the entries was completed, the rooms were measured, the distance to the center of each cross-cut being noted.

In keeping thenotes the system used was chosen because of its simplicity and compactness. On the left hand page we have the traverse, and on the right hand page the sketch showing the location of the stations, the cross-cuts, and the rooms. All places stopped are shown by a line drawn across at ~~the face~~, while the work-

ing places are left open for further extention. The left hand page also shows the distance of each station from themouth of the entry in the entry in which the main traverse is carried. Two columns are left blank. These, if the work of extending the survey and setting sights is to be continued after the survey, can be used for total latitudes and departures of the stations. Having these latitudes and departures in the note book sometimes saves a lot of time and trouble in the way of a t trip to the office and back again.

The system of numbering the stations was to use the number of the entry with consecutive numbers from 0 to 9. For instance all stations in the 21st East would be given numbers from 210 to 219, and in the 4th North from 40 to 49.

PART II

OFFICE WORK.

The Map.

The first thing considered in making the map was the size of the paper. This was figured on the basis of a scale of 200 feet to the inch, which is the common scale used in mine map work. A good way to do this is to sketch the boundary on a piece of scrap paper, and figure the difference in latitude or departure between the two extremes in each direction. Reduce these distances to inches by dividing by two hundred, and make a note of the distances on the sketch. Allow two or three inches additional for each side and cut the paper to this size. Now figure from the total coordinate of the extreme point and the distance decided on for margin how far from the edge the first coordinate line will come. To this distance add some multiple of five inches enough to bring the point near the center of the paper. Through this point and as near parallel to the edge scaled from as possible draw a line across the paper. Next figure the coordinate line from an adjacent edge in

the same manner, and extend to the center of the paper along the line drawn. At this point erect a perpendicular to this line by some geometric method. From these lines draw lines at intervals of five inches, ink them with a fine line, and at the edge of the paper letter the distance they represent. The paper is now prepared for starting the map. In all the following work a scale of forty parts to theinch was used, this making each small division equal to five feet.

First the boundary and property lines were drawn, the corners being platted by their coordinates. The township line was made a heavy broken line to distinguish it from the other lines. The roads were shown by fine broken lines. The names of the property owners were printed near the center of their property. The coordinates of the corners and the bearings of the lines were put on the map for convenience as a quick reference.

This completing the surface lines, all the underground stations were then platted, a small circle drawn around them, and connected by a fine broken line. This was first done with pencil and then inked with colored ink. The number of the station was noted near it.

Next the cross-cuts and room necks were scaled and the entries sketched according to the measurement given in the field notes. The rooms were then added, and fi-

nally everything inked. Numbering the rooms and the entries completed the cloth back map.

The Tracing.

A piece of tracing cloth was cut about the size of the cloth back map, and tacked down over it. With pen and ink everything on the map was traced on tracing cloth except the stations, the coordinates of the corners, and the bearings of the boundary lines. With a pencil, a line was traced of the traverse in the Main North and the 21st East entries. The tracing was then removed and placed over an old map in order that the abandoned and enaccessible workings could be added. These had to be fitted in the best way possible, using the penciled traverse line and the places that had holed through to the old workings as a guide. Arrows showing the course the air travelled were then put on the tracing. On this tracing they were put on with ink to make them permanent, but in making a tracing that is to be extended year after year it is well to put these arrows on with a soft lead pencil, as the course of the air may be changed, and in such a case the arrows could easily be erased and changed to correspond.

Only the title and the arrow showing the north point were all that were now left to draw on the tracing. Not

too much care can be taken in the making of a neat title. The title was first drawn on coordinate paper, the coordinate lines serving as an aid in blocking out the letters. Then it was traced on to the tracing. On the addition of the arrow, the tracing was complete.

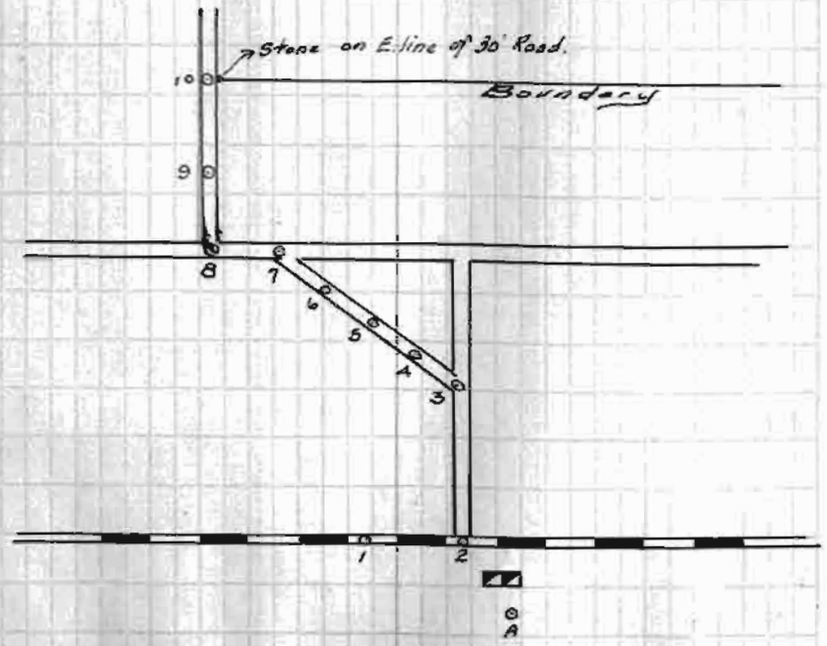
PART III

FIELD NOTES.

SURFACE SURVEY — NORTH BOUNDARY

Sta.	Azi.	Dist.
A - 1	292°09'	324.5
1 - 2	89°20'	253.65
2 - 3	0°38'	2518.4
3 - 4	269°44'	994.5
4 - 5	309°55'	1076.4
5 - 6	308°59'	1225.4
6 - 7	309°28'	1030.9
7 - 8	274°17'	172.8
8 - 9	359°30'	304.1
9 - 10	358°38'	1010.9
10 - Stone	90°00'	15.0

See Shaft Plumbing for Sta. "A"

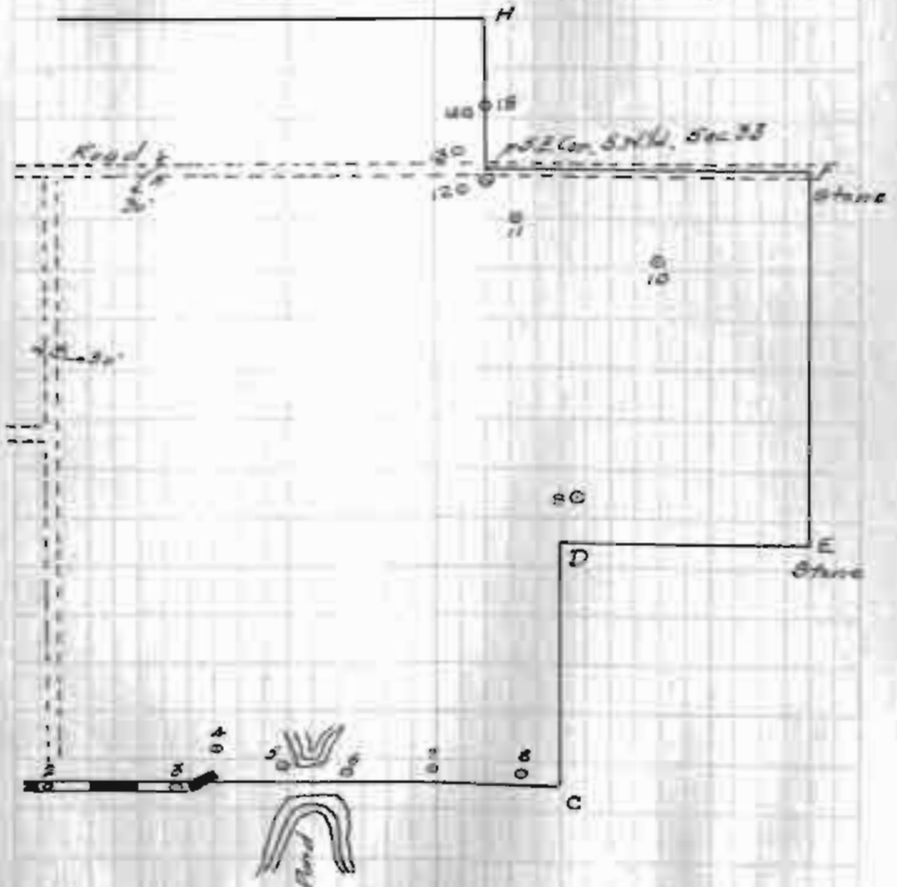


Sta 142 = Spad in tie.

SURFACE SURVEY — EAST BOUNDARY

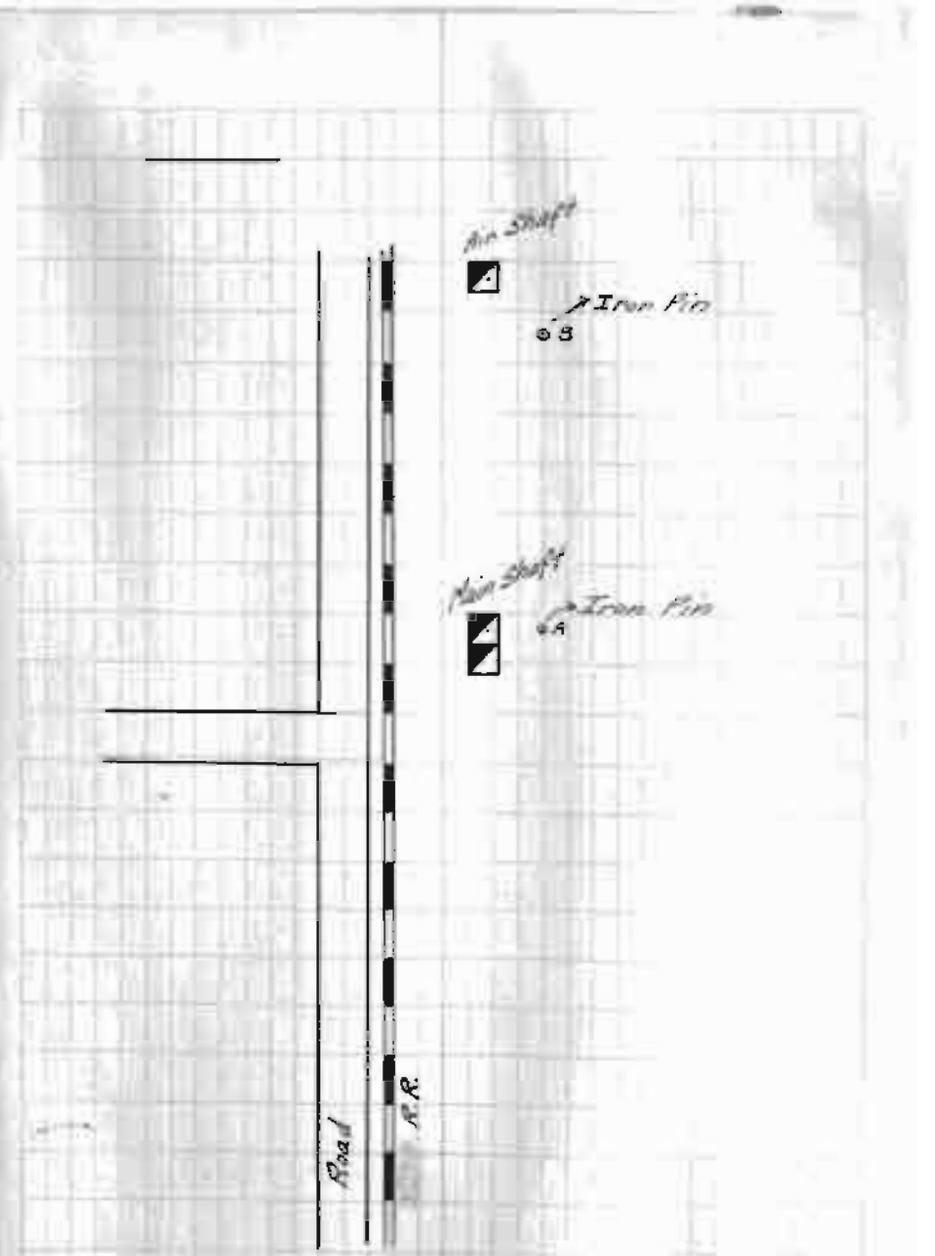
Sta.	Azi.	Dist.
2-3	90°54'	1260.4
3-4	66°33'	211.7
4-5	83°47'	469.6
5-6	99°17'	472.5
6-7	90°58'	644.1
7-8	92°33'	775.3
8-C	195°22'	17.9
8-D	1°23'	1595.0
8-9	1°23'	1685.0
9-E	94°37'	1644.9
9-10	10°27'	1510.4
10-F	48°00'	1878.9
10-11	321°06'	1216.7
11-12	319°49'	479.3
12-G	48°20	9.4
12-13	358°53'	95.8
13-14	2°30'	188.9
14-15	88°22'	4.3
15-H	0°32'	1063.9

See North Boundary Survey for Sta. 2.



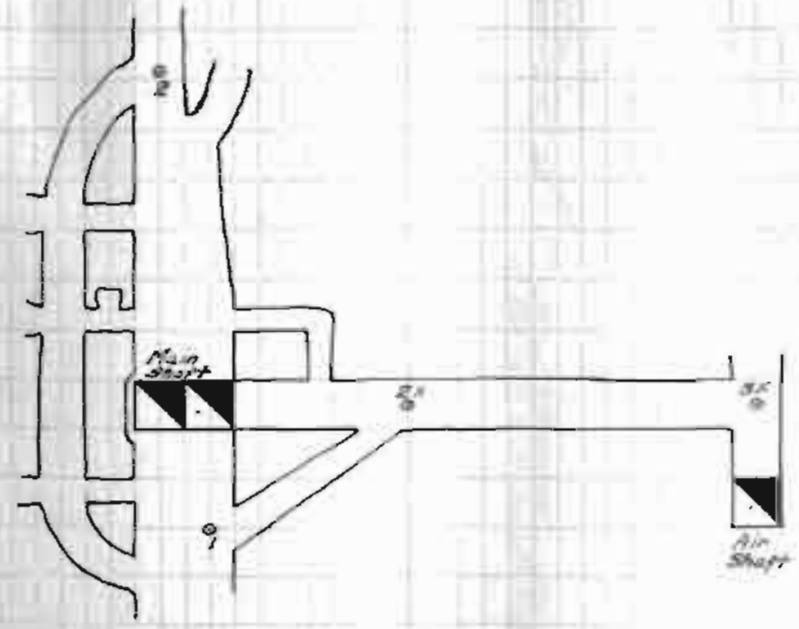
SHAFT PLUMBING - TOP

Sta.	Azi.	Dist.
A-M.S.Hire	5°18'	24.70
A-B	96°25	250.90
B-A.S.Hire	77°07'	51.20



SHAFT PLUMBING - Bottom

Sta	Azi.	Dist	
1-2	0°00'	216.1	→ Bearing Assumed
1-MS Wire	359°44'	44.95	
1-2X	47°04'	69.1	
2X-3X	90°10'	245.3	
3X-AS Wire	178°40'	40.9	



Sta.	MAIN Azi.	NORTH Dist.	
1-2	0°20'	215.9	
2-3	0°21'	770.0	At M.H. #11
3-4	0°12'	349.5	Near MH. #17
4-5	355°25'	114.8	
5-6	3°14'	272.0	At M.H. #23
6-7	0°10'	562.9	Between MH. 33 and 34
7-8	359°51'	243.3	At South end of Pass Porting
8-10	0°41'	467.0	At 13th East
10-11	0°43'	232.5	At M.H. #52
11-12	0°54'	287.0	" " #56
12-13	0°08'	263.2	" " #60
13-14	359°34'	259.0	Near M.H. #64
14-15	359°00'	365.7	At 19th West
15-16	0°00'	450.5	At 21st East.

21st East.

Sta.	Azi	Dist.	Total Dist.
16 - Z10	66° 29'	45.5	0+45.5
Z10 - Z11	81° 50'	88.2	1+33.7
Z11 - Z12	96° 41'	140.5	2+74.2
Z12 - Z13	90° 13'	150.7	4+24.9
Z13 - Z14	92° 53'	262.7	6+87.6
Z14 - 20	90° 45'	713.4	14+01.0
20 - Z15	92° 20'	84.0	14+85.0
Z15 - Z16	90° 36'	309.0	17+94.0
Z16 - 30	93° 53'	15.6	18+09.6
30 - 40	90° 38'	39.9	18+49.5
40 - Z17	91° 05'	413.3	22+62.8
Z17 - 50	90° 00'	15.4	22+78.2
50 - 60	90° 00'	39.9	23+18.1
60 - Z18	92° 39'	215.5	25+33.6
Z18 - Z19	90° 00'	73.9	26+07.5
Z18 - Z20	34° 32'	47.4	
Z20 - Z21	90° 00'	57.9	

At overcast

At Room I

Near M.H. #4

At M.H. #7

At M.H. #12

At 2nd S.

At 2nd N.

At 3rd N. — XCL - 25, 87, 149, 210, 278
Parting 33 - 291, XCR 195, 23' P.Iler

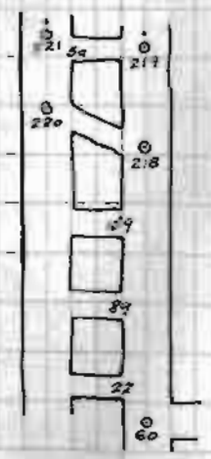
At 3rd S.

At 4th S.

At 5th N — XCL : 25, 78, 148, 220, 284, 347

At 5th S.

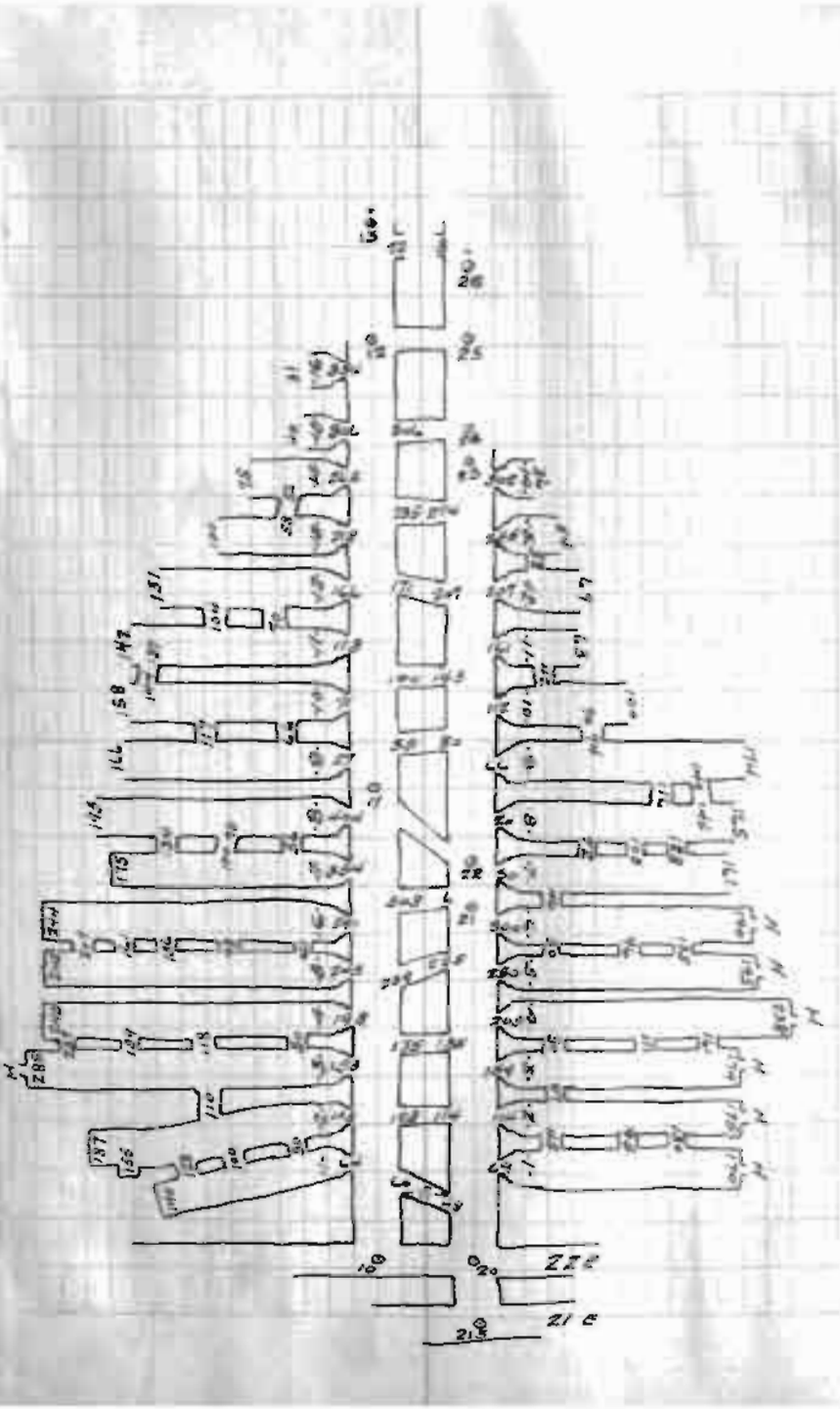
At 6th S.



1st & 2nd North - 22 E.

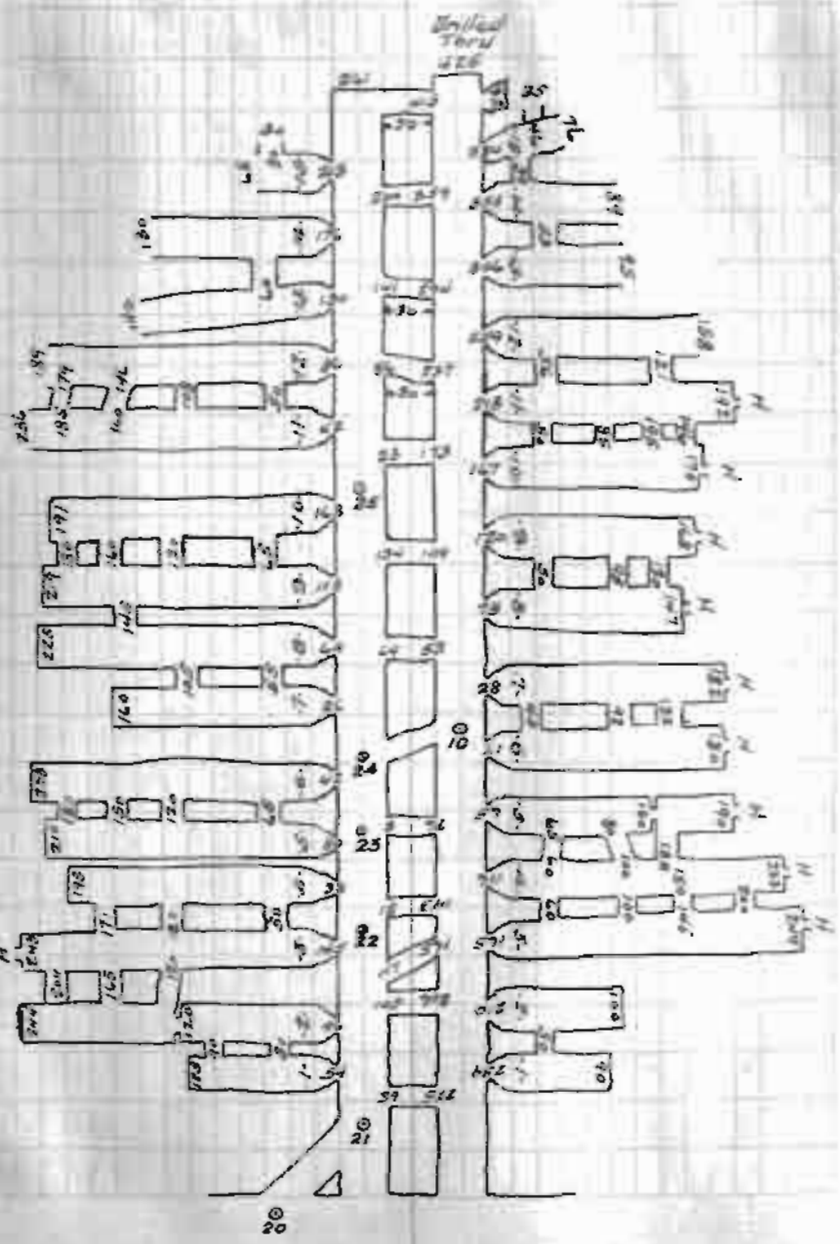
Sta.	Azi	Dist	Total Dist
215-20	347°06'	41.5	0+00
20-21	1°39'	315.8	3+15.8
21-22	356°22'	55.8	3+71.6
22-23	2°05'	317.7	6+89.3
23-24	348°25'	27.0	7+16.3
24-25	3°23'	68.6	7+84.9
25-26	0°00'	63.6	8+48.5

20-10	282°45'	58.7
22-11	322°35'	53.0
25-12	272°25'	39.0
12-13	0°00'	98.3



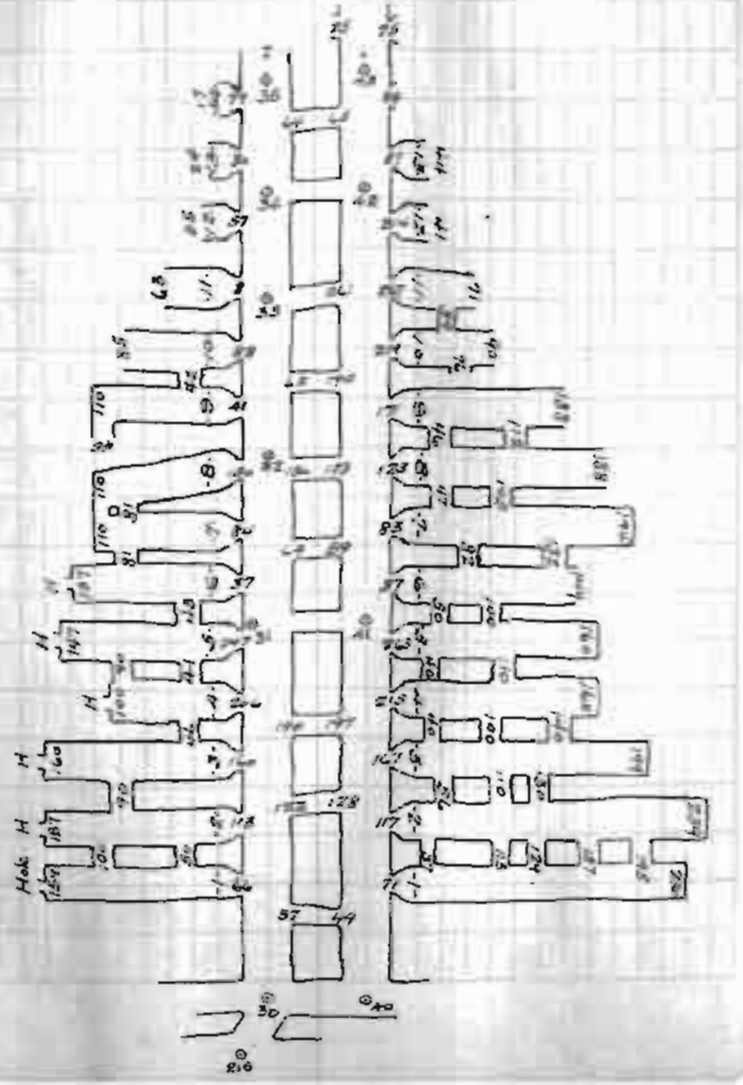
1st & 2nd South – 21st E.

Sta	Azi.	Dist.	Total Dist
20 – 21	206°39'	29.5	0+29.5
21 – 22	171°35'	152.6	1+82.1
22 – 23	180°47'	85.6	2+67.7
23 – 24	187°29'	63.9	3+31.6
24 – 25	184°37'	173.3	5+04.9
25 – Face	181°25'	261.0	7+65.9
24 – 10	252°40'	50.3	



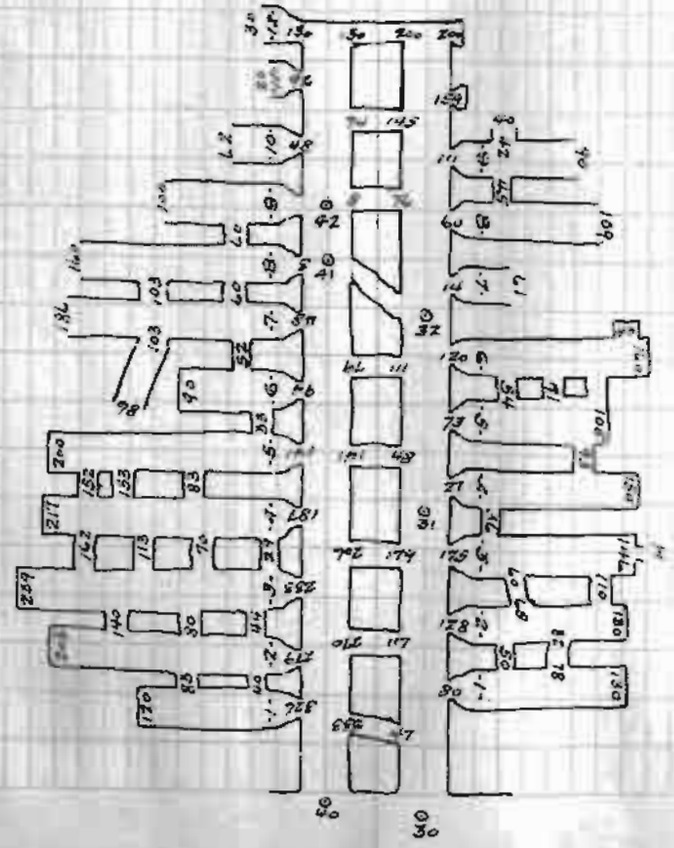
3rd & 4th North - 22nd E.

Sta.	Azi.	Dist.	Total Dist.
216 - 30	29° 48'	42.6	0+00
30 - 31	359° 29'	258.8	2+58.8
31 - 32	5° 21'	137.4	3+96.2
32 - 33	359° 49'	125.7	5+21.9
33 - 34	8° 19'	72.9	5+94.8
34 - 35	351° 22'	84.3	6+79.1
35 - sights	5° 00'	24.3	change sights at 127' from 35
30 - 40	90° 36'	39.2	
31 - 41	73° 40'	46.0	
34 - 42	81° 51'	31.7	
42 - 43	3° 12'	107.9	
43 - sight	0° 00'		



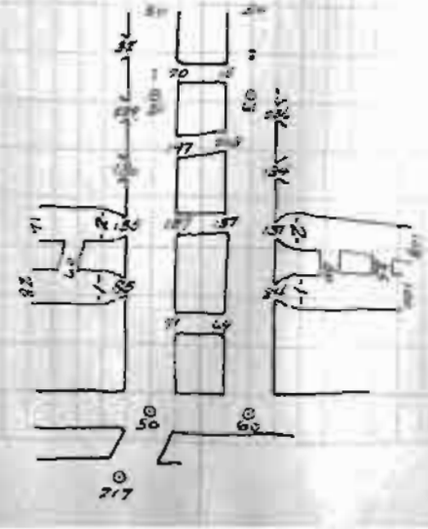
3rd & 4th South - 21st E.

Sta.	Azi.	Dist.	Total Dist.
30 - 31	182°54'	203.9	2+03.9
31 - 32	177°24'	163.4	3+67.3
32 - FACE	180°03'	204.0	5+71.3
30 - 40	90°38'	39.9	
32 - 41	134°35'	39.1	
41 - 42	162°54'	41.7	
42 - FACE	178°52'	135.0	



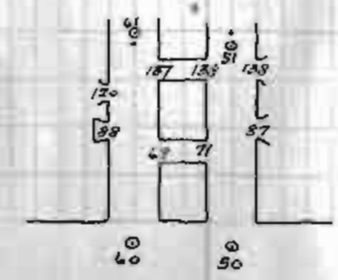
5th & 6th North - 22nd E.

Sta.	Azi	Dist.	Total Dist.
217 - 50	34°35'	448	0+00
50 - 51	0°56'	250.0	4+50.0
51 - sights	0°00'	19.0	
50 - 60	85°57'	39.0	
60 - 61	0°57'	258.0	
61 - sights	0°00'	24.0	



5th & 6th South – 21st E.

Sta.	Azi.	Dist.	Total Dist.
50-51	180°45'	163.3	1+63.3
60-61	181°00'	179.5	



PART IV

TRAVERSE SHEETS.

(Gurden's Traverse Tables used in calculating latitudes and departures).

Survey NORTH BOUNDARY [redacted] Sheet No. Mine 3

TRAVERSE SHEET

Entry SURFACE

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
A									4826 26	9833 04	
A - 1	292°09'	N67°51' W	3245	112.35			300 55		4713 91	9532 49	
1 - 2	89° 20'	N89°20' E	2536 5	2.97		2536 4			4710 94	9786 13	
2 - 3	0° 38'	N0°38' E	2518 4	2518.25		27 83			2192 69	9813 96	
3 - 4	269°44'	S89°44' W	9945		4 63		994 49		2197 32	8819 47	
4 - 5	309°55'	N50°05' W	1076 4	690.69			825 58		1506 63	7993 89	
5 - 6	308°59'	N51°01' W	1225 4	770.89			952.53		735 74	7041 36	
6 - 7	309°28'	N50°32' W	1030 9	655.27			795 84		80 47	6245 52	
7 - 8	274°17'	N85°43' W	172 8	12 91			172 32		67 56	6078 20	
8 - 9	359°30'	N0°30' W	304 1	304.09			2 66	236 53		6070 54	
9 - 10	358°38'	N1°22' W	1010 9	1010.62			24 11	1247 15		6046 43	
10 - Stone	90°00'	East	15 0			15 00		1247 15		6061 43	

Survey EAST BOUNDARY [redacted] Sheet No. Mine 3

TRAVERSE SHEET

Entry SURFACE

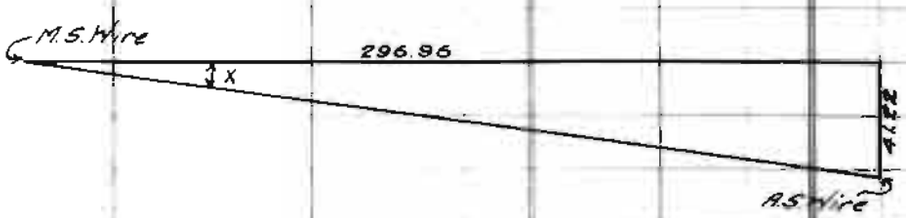
STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
2									4710 94	9786 13	
2 - 3	90°54'	S89°06'E	1260 4		19 80	1260.24			4730 74	11046 37	
3 - 4	66°33'	N66°33'E	211 7	84.25		194 21			4646 49	11240 58	
4 - 5	83°47'	N83°47'E	469 6	50.85		466 84			4595 64	11707 42	
5 - 6	99°17'	S80°43'E	472 5		76 22	466 31			4671 86	12173 73	
6 - 7	90°58'	S89°02'E	644 1		10 87	644 01			4682 73	12817 74	
7 - 8	92°33'	S87°27'E	775 3		34 60	774 53			4717 23	13592 27	
8 - C	195°22'	S15°22'W	17 9		17 26		4 74		4734 49	13587 53	
8 - D	1°23'	N1°23'E	1595 0	1594.53		38 50			3122 70	13630 77	
8 - 9	1°23'	N1°23'E	1685 0	1684.51		40 68			3032 72	13632 95	
9 - E	94°37'	S85°23'E	1644 9		132 39	1639 57			3165 11	15272 52	
9 - 10	10°27'	N10°27'E	1510 4	1485.34		273 95			1547 38	13906 90	
10 - F	48°00'	N48°00'E	1878 9	1257.23		1396 30			290 15	15303 20	
10 - 11	321°06'	N38°54'W	1216 7	946.89			764 05		600 49	13142 85	
11 - 12	319°49'	N40°11'W	479 3	366.17			309 26		234 32	12833 59	
12 - G	48°20'	N48°20'E	9 4	6.25		7 02			228 07	12840 61	
12 - 13	358°53'	N1°07'W	95 8	95.78			1 87		138 54	12831 72	
13 - 14	2°30'	N2°30'E	183 9	183.73		8 02		45 19		12839 74	
14 - 15	88°22'	N88°22'E	4 3	.12		4 30		45 31		12844 04	
15 - H	0°32'	N0°32'E	1063 9	1063.86		9 91		1109 17		12853 95	

Survey [redacted] Sheet No. _ Mine 3

TRAVERSE SHEET

Entry SHAFT PLUMBING – TOP

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE North	LATITUDE South	DEPARTURE East	DEPARTURE West	TOTAL LATITUDE AND DEPARTURE North	TOTAL LATITUDE AND DEPARTURE South	TOTAL LATITUDE AND DEPARTURE East
A									4826 26	9833 04
A-M.S.Wire	5°18'	N5°18'E	24 70	24.60		2 28			4801 66	9835 32
A-B	96°25'	S83°35'E	250 90		28.04	249 33			4854 80	10082 37
B-A.S.Wire	77°07'	N77°07'E	51 20	11.42		49 91			4842 88	10132 28



			TOTAL LATITUDE AND DEPARTURE North	TOTAL LATITUDE AND DEPARTURE South	TOTAL LATITUDE AND DEPARTURE East
A.S.Wire				4842 88	10132 28
M.S.Wire				4801 66	9835 32
				41 22	296 96

$\tan \angle X = \frac{41.22}{296.96} = .13881$

$\angle X = 7°54'$

M.S.Wire –				
A.S.Wire	97°54'	S82°06'E	299 80	

[redacted]

Sheet No. _____ Mine 3

TRAVERSE SHEET

Entry SHAFT PLUMBING – BOTTO

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE North	LATITUDE South	DEPARTURE East	DEPARTURE West	TOTAL LATITUDE AND DEPARTURE North	TOTAL LATITUDE AND DEPARTURE South	TOTAL LATITUDE AND DEPARTURE East	TOTAL LATITUDE AND DEPARTURE West
1 – Z	0°00'	Assumed North						M.S.Wire		297.05	
M.S.Wire-1	179°44'	S0°16'E	44.95		44.95	.21			Y		
1 – 2X	47°04'	N47°04'E	69.10	47.07		50.59					A.S.Wi
2X – 3X	90°10'	S89°50'E	245.30		.72	245.30					
3X-A.S.Wire	178°40'	S1°20'E	40.90		40.89	.95		tan ∠Y =	39.49	= .132944	
				47.07	86.56	297.05			297.05		
					47.07			∠Y = 7°34'			
					39.49						
M.S.Wire –											
A.S.Wire	97°34'										
Azimuth Correction =		+0°20'									
Corrected Bottom Survey –											
M.S.Wire-1	180°04'	S0°04'W	44.95		44.95		.05		4846.61	9835.27	
1 – 2X	47°24'	N47°24'E	69.10	46.77		50.86			4799.84	9886.13	
2X – 3X	90°30'	S89°30'E	245.80		2.21	245.80			4802.05	10131.93	

Survey [redacted] Sheet No. Mine 3

TRAVERSE SHEET

Entry Main North.

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE North	LATITUDE South	DEPARTURE East	DEPARTURE West	TOTAL LATITUDE AND DEPARTURE North	South	East	West
1-2	0°20'	N0°20'E	2159	215.90		1 25			4630 71	9836 52	
2-3	0°21'	N0°21'E	7700	769.99		4 75			3860 72	9841 27	
3-4	0°12'	N0°12'E	349.5	349.50		1 22			3511 22	9842 49	
4-5	355°25'	N4°35'W	114.8	114.43			9 17		3396 79	9833 32	
5-6	3°14'	N3°14'E	272.0	271.57		15 34			3125 22	9848 66	
6-7	0°10'	N0°10'E	562.9	562.90		1 64			2562 32	9850 30	
7-8	359°51'	N0°09'W	243.3	243.80			.64		2319 02	9849 66	
8-10	0°41'	N0°41'E	467.0	466.97		5 57			1852 05	9855 23	
10-11	0°43'	N0°43'E	232.5	232.48		2 91			1619 57	9858 14	
11-12	0°54'	N0°54'E	287.0	286.97		4 51			1332 60	9862 65	
12-13	0°08'	N0°08'E	263.2	263.20		61			1069 40	9863 26	
13-14	359°34'	N0°26'W	259.0	258.99			1.96		810 41	9861 30	
14-15	359°00'	N1°00'W	365.7	365.66			6 38		444 76	9854 92	
15-16	0°00'	North	450.5	450.50				5 74		9854 92	

Survey _____ [redacted] Sheet No. _____ Mine 3

Entry 21st East

TRAVERSE SHEET

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
16								5 74		9854 92	
16 - 210	66° 29'	N66°29'E	45 5	18.16		41 72		23 90		9896 64	
210 - 211	81° 50'	N81°50'E	88 2	12.53		87 31		36 43		9983 95	
211 - 212	96° 41'	S83°19'E	140 5		16 35	139 55		20 08		10123 50	
212 - 213	90° 13'	S89°47'E	150 7		57	150 70		19 51		10274 20	
213 - 214	92° 53'	S87°07'E	262 7		13 22	262 37		6 29		10536 57	
214 - 20	90° 45'	S89°15'E	713 4		9 33	713 34			3 04	11249 91	
20 - 215	92° 20'	S87°40'E	84 0		3 42	83 93			6 46	11333 84	
215 - 216	90° 36'	S89°24'E	309 0		3 23	308 98			9 69	11642 82	
216 - 30	93° 53'	S86°07'E	15 6		1 06	15 57			10 75	11658 39	
30 - 40	90° 38'	S89°22'E	39 9		44	39 90			11 19	11698 29	
40 - 217	91° 05'	S88°55'E	413 3		7 81	413 23			19 00	12111 52	
217 - 50	90° 00'	East	15 4			15 40			19 00	12126 92	
50 - 60	90° 00'	"	39 9			39 90			19 00	12166 82	
60 - 218	92° 39'	S87°21'E	215 5		9 96	215 27			28 96	12382 09	
218 - 219	90° 00'	East	73 9			73 90			28 96	12455 99	
218 - 220	34° 32'	N34°32'E	47 4	39 25		26 87		10 09		12408 96	
220 - 221	90° 00'	East	57 9			57 90		10 09		12466 86	

Survey _____ [redacted] Sheet No. _____ Mine 3

TRAVERSE SHEET

Entry 1st & 2nd North - 22nd E.

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
215									6.46	11333.84	
215-20	347°06'	N12°54'W	413	40.26			9.22	33.80		11324.62	
20-21	1°39'	N1°39'E	315.8	315.61		9.10		349.47		11333.72	
21-22	355°22'	N4°38'W	55.8	55.62			4.50	405.09		11329.22	
22-23	2°05'	N2°05'E	317.7	317.49		11.55		722.58		11340.77	
23-24	348°25'	N11°35'W	27.0	26.45			5.42	749.03		11335.35	
24-25	3°23'	N3°23'E	68.6	68.48		4.05		817.51		11339.40	
25-26	0°00'	North	63.6	63.60				881.11		11339.40	
20-10	282°43'	N77°17'W	38.7	8.51			37.75	42.31		11286.87	
22-11	322°35'	N37°25'W	53.0	42.09			32.20	447.18		11297.02	
25-12	272°25'	N87°35'W	39.0	1.64			38.97	819.15		11300.43	
12-13	0°00'	North	83.3	83.30				902.45		11300.43	

Survey [redacted] Sheet No. _____ Mine 3

TRAVERSE SHEET

Entry 1st & 2nd South - 21st E.

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
20									3 04	11249 91	
20 - 21	206°-39'	S26°39'W	29 5		26 37		13 23		29 41	11236 68	
21 - 22	171°35'	S8°25'E	152 6		150 96	22 34			180 36	11259 02	
22 - 23	180°47'	S0°47'W	85 6		85 59		1 17		265 95	11257 85	
23 - 24	187°29'	S7°29'W	63 9		63 35		8 33		329 30	11249 52	
24 - 25	184°37'	S4°37'W	173 3		172 74		13 95		502 04	11235 57	
25 - FACE	181°25'	S1°25'W	261 0		260 92		6 45		762 96	11229 12	
24 - 10	252°40'	S72°40'W	50 3		14 99		48 02		344 29	11201 50	

Survey _____ [redacted] Sheet No. _____ Mine 3

TRAVERSE SHEET

Entry 3rd & 4th North - 22nd E

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
216									9 69	11642 82	
216 - 30	29° 48'	N29° 48' E	42 6	36 97		21 17		27 28		11663 99	
30 - 31	359° 29'	N 0° 31' W	258 8	258 79			2 33	286 07		11661 66	
31 - 32	5° 21'	N 5° 21' E	137 4	136 80		12 81		422 87		11674 47	
32 - 33	359° 49'	N 0° 11' W	125 7	125 70			40	548 57		11674 07	
33 - 34	8° 19'	N 8° 19' E	72 9	72 13		10 54		620 70		11684 61	
34 - 35	351° 22'	N 8° 38' W	84 3	83 35			12 66	704 05		11671 95	
80 - 40	90° 36'	S 89° 24' E	39 2		41	39 20		26 87		11703 19	
31 - 41	73° 40'	N 73° 40' E	46 0	12 94		44 14		299 01		11705 80	
34 - 42	81° 51'	N 81° 51' E	31 7	4 49		31 38		625 19		11715 99	
42 - 43	3° 12'	N 3° 12' E	107 9	107 73		6 02		732 92		11722 01	

Survey [redacted] Sheet No. Mine 3

TRAVERSE SHEET

Entry 3rd & 4th South - 21st E.

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
30									10 75	11658 39	
30-31	182°54'	S2°54'W	203 9		203 64		10 32		214 39	11648 07	
31-32	177°24'	S2°36'E	163 4		163 24	7 41			377 63	11655 48	
32-FACE	180°03'	S0°03'W	204 0		204 00		18		581 63	11655 30	
30-40	90°38'	S89°22'E	39 9		44	39 90			11 19	11698 29	
32-41	134°35'	S45°25'E	39 1		27 45	27 85			405 08	11683 33	
41-42	162°54'	S17°06'E	41 7		39 86	12 27			444 94	11695 60	
42-FACE	178°52'	S1°08'E	135 0		134 97	2 67			579 91	11698 27	

Survey _____ [redacted] Sheet No. _____ Mine 3

TRAVERSE SHEET

Entry 5th & 6th North - 22nd E.

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
217									19 00	12111 52	
217-50	34°35'	N34°35'E	448	36 89		25 42		17 89		12136 94	
50-51	0°56'	N0°56'E	250 0	249 97		4 07		267 86		12141 01	
50-60	85°57'	N85°57'E	39 0	2 75		38 90		20 64		12175 84	
60-61	0°57'	N0°57'E	258 0	257 97		4 28		278 61		12180 12	

Survey [redacted] Sheet No. Mine 3

TRAVERSE SHEET

Entry 5th & 6th South - 21st E.

STA.	AZIMUTH	BEARING	DISTANCE	LATITUDE		DEPARTURE		TOTAL LATITUDE AND DEPARTURE			
				North	South	East	West	North	South	East	West
50									19 00	12126 92	
50 - 51	180° 45'	S 0° 45' W	163 3		163 29		2 13		182 29	12124 79	
60									19 00	12166 82	
60 - 61	181° 00'	S 1° 00' W	179 5		179 47		3 14		198 47	12163 68	

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